CLAIMS

1. In a multidimensional digital frame structure, a method for variably programming the quantity of frame synchronization bytes, the method comprising:

defining an overhead section in a frame structure having a predetermined number of bytes; and

selecting the number of bytes in the overhead section to be used for frame synchronization.

2. The method of claim 1 wherein the overhead section includes a first plurality of bytes; and

wherein selecting the number of frame synchronization bytes in the overhead section includes selecting a number of bytes in the range from zero to the first plurality.

3. The method of claim 2 further comprising:

defining a superframe structure with a predetermined number of frames per superframe; and

wherein selecting the number of frame synchronization bytes in the overhead section includes selecting the number of bytes in the overhead section of each frame.

4. The method of claim 3 wherein defining a superframe structure with a predetermined number of frames per superframe includes defining a first and a second frame in the superframe; and

wherein selecting the number of frame synchronization bytes in the overhead section includes selecting a first number of bytes in the first frame and a second number of bytes in the second frame.

5. The method of claim 4 wherein defining a superframe structure with a predetermined number of frames per superframe includes defining a superframe consisting of a first, second, third, and fourth frame; and

wherein selecting the number of frame synchronization bytes in the overhead section includes selecting a first number of frame synchronization bytes in the first frame, a second number of frame synchronization bytes in the second frame, a third number of frame synchronization bytes in the third frame, and a fourth number of frame synchronization bytes in the fourth frame.

6. The method of claim 5 wherein selecting the number of frame synchronization bytes in the overhead section includes selecting a second, third, and fourth number of bytes equal to zero.

7. The method of claim 2 further comprising:

selecting the location of the frame synchronization bytes in the overhead section.

8. The method of claim 7 wherein defining the overhead section of each frame includes defining a first plurality of overhead byte locations; and

wherein selecting the location of the frame synchronization bytes in the overhead section includes selecting locations in the range from zero to the first plurality of byte locations.

9. The method of claim 8 wherein selecting the number of frame synchronization bytes in the overhead section includes selecting a first number of bytes; and

wherein selecting the location of the frame synchronization bytes in the overhead section includes selecting the first number of byte locations.

10. The method of claim 2 further comprising:

selecting the value of the frame synchronization bytes in the overhead section.

11. The method of claim 10 wherein defining the overhead section includes defining each byte to have a second plurality of bits; and

wherein selecting the value of the frame synchronization bytes includes selecting a second plurality of bits for each frame synchronization byte.

12. The method of claim 11 wherein selecting the number of frame synchronization bytes includes selecting a plurality of frame synchronization bytes having a plurality of byte values.

13. The method of claim 12 wherein selecting the number of frame synchronization bytes includes, for each frame, selecting a number of frame synchronization byte values in the range from zero to the first plurality.

14. The method of claim 13 wherein selecting the number of frame synchronization byte values includes selecting a first number of frame synchronization bytes, having a first value, and a second number of frame synchronization bytes, having a second value.

15. The method of claim 2 further comprising:

selecting the bit error rate required for the recognition of a frame synchronization byte.

16. The method of claim 15 wherein selecting a frame synchronization byte bit error rate includes selecting an average bit error rate for the selected number of frame synchronization bytes.

17. A method for variably programming the quantity of frame synchronization bytes in the communication of a multidimensional digital frame structure, the method comprising:

selecting the number of frame synchronization bytes in the overhead section of a transmitted frame;

sending the frame;

receiving the frame; and

synchronizing the received frame in response to recognizing frame synchronization bytes.

18. The method of claim 17 further comprising:

for each frame, selecting the number of frame synchronization bytes required for the recognition of a received frame.

19. The method of claim 18 further comprising:

selecting the number of consecutive frames that must be recognized; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to the selected number of recognized frames.

20. The method of claim 19 wherein selecting the number of frame synchronization bytes required for the recognition of a received frame includes selecting a number of bytes for each frame of the superframe; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes recognizing the selected number of frame synchronization bytes in each frame of the superframe.

21. The method of claim 20 wherein selecting the number of frame synchronization bytes required for the recognition of a received frame includes selecting a first number of frame synchronization bytes for a first frame of a superframe; and

wherein synchronizing the received frame in response to recognizing frame synchronization bytes includes recognizing the first number of frame synchronization bytes in the first frame of the superframe.

22. The method of claim 20 wherein selecting the number of frame synchronization bytes in the overhead section of a transmitted frame includes selecting a first number of frame synchronization bytes for a first frame;

wherein selecting the number of frame synchronization bytes required for the recognition of a received frame includes selecting the first number of frame synchronization bytes for the first frame.

23. The method of claim 20 wherein selecting the number of frame synchronization bytes in the overhead section of a transmitted frame includes selecting a first number of bytes for a first frame;

wherein selecting the number of frame synchronization bytes required for the recognition of a received frame includes selecting a second number of bytes, less than the first number, for the first frame of the superframe; and

wherein synchronizing the received frame includes synchronizing in response to recognizing the second number of frame synchronization bytes in the first frame.

24. The method of claim 18 further comprising:

selecting the bit error rate required for the recognition of a frame synchronization byte.

25. The method of claim 24 wherein selecting a bit error rate includes selecting an average bit error rate for the selected number of frame synchronization bytes.

26. The method of claim 25 wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes recognizing frame synchronization bytes having a bit error rate less than, or equal to, the selected frame synchronization bit error rates.

27. The method of claim 26 further comprising:

defining a superframe structure with a predetermined number of frames per superframe; and

wherein selecting the number of frame synchronization bytes in the overhead section of a transmitted frame includes selecting the number of bytes to be used for synchronization in the overhead section of each frame of the superframe;

wherein sending the frame includes sending frames in the superframe structure; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes recognizing frame synchronization bytes in each frame of the superframe.

28. The method of claim 18 further comprising:

selecting the location of the bytes to be used for the frame synchronization of received frames; and

wherein synchronizing the received frames in response to recognizing the frame synchronization bytes includes recognizing frame synchronization bytes in response to the selected locations of the frame synchronization bytes.

29. The method of claim 28 wherein selecting the location of the frame synchronization bytes of a received frame includes selecting a first number of locations; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to recognizing frame synchronization bytes in the first number of selected locations.

30. The method of claim 29 wherein selecting the location of the frame synchronization bytes includes selecting a first number of locations in a first frame of the superframe, and a second number of locations in a second frame; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to recognizing frame synchronization bytes in the first number of selected locations in the first frame and the second number of selected locations in the second frame.

31. The method of claim 29 further comprising:

selecting the location of frame synchronization bytes in the overhead section of a transmitted frame.

32. The method of claim 31 wherein selecting the location of frame synchronization bytes in the overhead section of a transmitted frame includes selecting a first number of locations for a first number of frame synchronization bytes;

wherein selecting the location of the bytes to be used for frame synchronization in the received frame includes selecting the first number of locations for a first number of frame synchronization bytes.

33. The method of claim 31 wherein selecting the location of frame synchronization bytes in the overhead section of a transmitted frame includes selecting a first number of locations for a first number of frame synchronization bytes;

wherein selecting the location of the bytes to be used for frame synchronization of a received frame includes selecting a second number of locations for a second number of frame synchronization bytes, less than the first number; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to recognizing frame synchronization bytes in the second number of selected locations.

34. The method of claim 18 further comprising:

selecting the value of each frame synchronization byte; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes recognizing the value of the frame synchronization bytes.

35. The method of claim 34 wherein selecting the value of each frame synchronization byte includes selecting a first number of frame synchronization bytes having a first value and a second number of frame synchronization bytes having a second value; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to recognizing the first number of frame synchronization bytes having the first value and the second number of frame synchronization bytes having the second value.

36. The method of claim 34 wherein selecting the value of each frame synchronization byte includes selecting a first number of frame synchronization bytes having a first value in a first frame and a second number of frame synchronization bytes having a second value in a second frame; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to recognizing the first number of frame synchronization bytes having the first value in the first frame and the second number of frame synchronization bytes having the second value in the second frame.

37. The method of claim 34 further comprising:

selecting the value of the frame synchronization bytes in a transmitted frame.

38. The method of claim 37 wherein selecting the value of frame synchronization bytes of a transmitted frame includes selecting a first number of frame synchronization bytes having a first value; and

wherein selecting the value of each frame synchronization byte in a received frame includes selecting a first number of frame synchronization bytes having the first value.

39. The method of claim 37 wherein selecting the value of frame synchronization bytes in the overhead section of a transmitted frame includes selecting a first number of frame synchronization bytes having a first value and a second number of frame synchronization bytes, having a second value;

wherein selecting the value of each frame synchronization byte in a received frame includes selecting a third number of frame synchronization bytes less than the first number, having the first value, and a fourth number of frame synchronization bytes less than the second number, having the second value; and

wherein synchronizing the received frame in response to recognizing the frame synchronization bytes includes synchronizing the received frame in response to recognizing the third number of frame synchronization bytes having the first value, and the fourth number of frame synchronization bytes having the second value.

40. The method of claim 17 further comprising:

following synchronization, falling out of synchronization in response to frame synchronization byte non-recognition.

41. The method of claim 39 further comprising:

selecting a number of consecutively non-recognized frames; and

wherein falling out of synchronizing in response to frame synchronization byte non-recognition includes falling out of synchronization in response to the selected number of consecutively non-recognized frames.

42. In a multidimensional digital frame structure, a transmitter system for variably programming the number of frame synchronization bytes, the system comprising:

a frame generator including an overhead generator to generate the overhead section of a frame, a payload generator to generate the payload section of the frame, and an encoder to provide forward error correction (FEC) for the frame; and

wherein the overhead generator includes an input to select the quantity of frame synchronization bytes in the overhead section.

43. The system of claim 42 wherein the frame generator supplies a frame with a first plurality of overhead bytes; and

wherein the overhead generator accepts commands to select a quantity of frame synchronization bytes in the range from zero to the first plurality.

44. The system of claim 43 wherein the frame generator forms a superframe structure with a predetermined quantity of frames per superframe; and

wherein the overhead generator supplies a selectable quantity frame synchronization bytes for the overhead section of each frame of the superframe.

45. The system of claim 44 wherein the frame generator forms a superframe with a first and a second frame; and

wherein the overhead generator supplies a first number of selected frame synchronization bytes for the first frame and a second number of frame synchronization bytes for the second frame.

46. The system of claim 45 wherein the frame generator forms a superframe consisting of a first, second, third, and fourth frame; and

wherein the overhead generator supplies a first number of overhead bytes for the first frame, a second number of bytes for the second frame, a third number of bytes for the third frame, and a fourth number of bytes for the fourth frame.

47. The system of claim 46 wherein the overhead generator selects a second, third, and fourth number of bytes equal to zero.

48. The system of claim 42 wherein the overhead generator has an input to accept commands for selecting the location of the bytes in the overhead section to be used for frame synchronization.

49. The system of claim 48 wherein the frame generator forms an overhead section in each frame with a first plurality of overhead byte locations; and

wherein the overhead generator selects the location of the frame synchronization bytes in the range from zero to the first plurality of byte locations.

50. The system of claim 49 wherein the overhead generator selects a first number of frame synchronization bytes in a first number of byte locations.

51. The system of claim 42 wherein the overhead generator has an input to accept commands for selecting the value of the bytes in the overhead section to be used for frame synchronization.

52. The system of claim 51 wherein the overhead generator selects a second plurality of bits for each frame synchronization byte value, where each byte includes the second plurality of bits.

53. The system of claim 52 wherein the overhead generator selects frame synchronization byte values from a plurality of byte values.

54. The system of claim 53 wherein the overhead generator selects frame synchronization byte values in the range from zero to the first plurality, for each frame.

55. The system of claim 54 wherein the overhead generator selects a first number of frame synchronization bytes, having a first value, and a second number of frame synchronization bytes, having a second value.

56. In a multidimensional digital frame structure, a receiver system for variably programming the number of frame synchronization bytes, the system comprising:

a frame receiver including an overhead receiver to receive the overhead section of a frame, a payload receiver to receive the payload section of the frame, and a decoder to provide a forward error corrected (FEC) frame; and

wherein the overhead receiver includes an input to select the quantity of frame synchronization bytes in the overhead section to be used for frame synchronization.

57. The system of claim 56 wherein the frame receiver supplies a frame with a first plurality of overhead bytes; and

wherein the overhead receiver accepts commands to select a quantity of frame synchronization bytes in the range from zero to the first plurality.

58. The system of claim 57 wherein the frame receiver forms a superframe structure with a predetermined number of frames per superframe; and

wherein the overhead receiver selects the number of frame synchronization bytes required for the recognition of each frame of the superframe.

59. The system of claim 58 wherein the frame receiver forms a superframe with a first and a second frame; and

wherein the overhead receiver selects a first number of selected frame synchronization bytes for the first frame and a second number of frame synchronization bytes for the second frame.

60. The system of claim 59 wherein the frame receiver forms a superframe consisting of a first, second, third, and fourth frame; and

wherein the overhead receiver selects a first number of overhead bytes for the first frame, a second number of bytes for the second frame, a third number of bytes for the third frame, and a fourth number of bytes for the fourth frame.

61. The system of claim 60 wherein the overhead receiver selects a second, third, and fourth number of bytes equal to zero.

62. The system of claim 56 wherein the overhead receiver has an input to accept commands for selecting the location of the bytes in the overhead section to be used for frame synchronization.

63. The system of claim 61 wherein the frame receiver forms an overhead section in each frame with a first plurality of overhead byte locations; and

wherein the overhead receiver selects the location of the frame synchronization bytes in the range from zero to the first plurality of byte locations.

64. The system of claim 62 wherein the overhead receiver selects a first number of frame synchronization bytes in the first number of byte locations.

65. The system of claim 56 wherein the overhead receiver has an input to accept commands for selecting the value of the bytes in the overhead section to be used for frame synchronization.

66. The system of claim 65 wherein the overhead receiver selects a second plurality of bits for each frame synchronization byte, where each byte includes a second plurality of bits.

67. The system of claim 66 wherein the overhead receiver selects frame synchronization byte values from a plurality of byte values.

68. The system of claim 67 wherein the overhead receiver selects frame synchronization byte values, in each frame, in the range from zero to the first plurality of byte values.

69. The system of claim 67 wherein the overhead receiver selects a first number of frame synchronization bytes, having a first value, and a second number of frame synchronization bytes, having a second value.

70. The system of claim 56 wherein the overhead receiver has an input to accept commands for selecting the bit error rate required for the recognition of a frame synchronization byte.

71. The system of claim 70 wherein the overhead receiver selects an average bit error rate for the selected number of frame synchronization bytes.

72. A system for variably programming the quantity of frame synchronization bytes in the communication of a multidimensional digital frame structure, the system comprising:

a transmitter with a frame generator including an overhead generator having an input to accept commands for selecting the quantity of frame synchronization bytes in the overhead section of a transmitted frame; and

a receiver with a frame receiver including an overhead receiver having an input to accept commands for selecting the quantity of frame synchronization bytes required for synchronizing a received frame, the overhead receiver synchronizing the frame in response to recognizing the frame synchronization bytes.

73. The system of claim 72 wherein the overhead receiver selects the number of consecutive frames that must be recognized; and

wherein the overhead receiver synchronizes the received frame in response to the selected number of recognized frames.

74. The system of claim 73 wherein the frame generator defines a superframe structure with a predetermined number of frames per superframe;

wherein the overhead generator selects a quantity of bytes to be used for synchronization in the overhead section of each frame of the superframe; and

wherein the overhead receiver recognizes frame synchronization bytes in each frame of the superframe.

75. The system of claim 74 wherein the overhead receiver selects the quantity of frame synchronization bytes required for recognition, for each frame.

76. The system of claim 75 wherein the overhead receiver selects a quantity of bytes for each frame of the superframe, and recognizes the selected quantity of frame synchronization bytes in each frame of the superframe.

77. The system of claim 76 wherein the overhead receiver selects a first number of frame synchronization bytes for a first frame of the superframe, and synchronizes the first frame by recognizing the first number of bytes in the first frame.

78. The system of claim 76 wherein the overhead generator selects a first number of frame synchronization bytes in the overhead section of a frame; and

wherein the overhead receiver selects the first number of frame synchronization bytes for the recognition of the first frame.

79. The system of claim 76 wherein the overhead generator selects a first number of frame synchronization bytes for a first frame; and

wherein the overhead receiver selects a second number of bytes, less than the first number, for the first frame, the overhead receiver synchronizing the received frame in response to recognizing the second number of frame synchronization bytes in the first frame.

80. The system of claim 72 wherein the overhead receiver has an input to accept commands for selecting the bit error rate required for the recognition of a frame synchronization byte.

81. The system of claim 80 wherein the overhead receiver selects an average bit error rate for the selected number of frame synchronization bytes.

82. The system of claim 81 wherein the overhead receiver recognizes frame synchronization bytes having a bit error rate less than, or equal to, the selected frame synchronization bit error rates.

83. The system of claim 72 wherein the overhead receiver accepts commands for selecting the location of the frame synchronization bytes of received frames, and wherein the overhead receiver synchronizes the received frame in response to recognizing frame synchronization bytes in the selected locations.

84. The system of claim 83 wherein the overhead receiver selects a first number of frame synchronization byte locations, and synchronizes the received frame in response to recognizing frame synchronization bytes in the first number of selected locations.

85. The system of claim 83 wherein the overhead receiver selects a first number of locations in a first frame of the superframe, and a second number of locations in a second frame, and synchronizes the received frame in response to recognizing frame synchronization bytes in the first number of selected locations in the first frame and the second number of selected locations in the second frame.

86. The system of claim 83 wherein the overhead generator selects a first number of locations for a first number of frame synchronization bytes; and

wherein the overhead receiver selects the first number of locations for the first number of frame synchronization bytes.

87. The system of claim 83 wherein the overhead generator selects a first number of locations for a first number of frame synchronization bytes; and

wherein the overhead receiver selects a second number of locations for a second number of frame synchronization bytes, less than the first number, and synchronizes the received frame in response to recognizing frame synchronization bytes in the second number of selected locations.

88. The system of claim 72 wherein the overhead receiver accepts commands for selecting the values of each frame synchronization byte, the overhead receiver synchronizing the received frame in response to recognizing the values of synchronization bytes.

89. The system of claim 88 wherein the overhead receiver selects a first number of frame synchronization bytes having a first value and a second number of frame synchronization bytes having a second value, the overhead receiver synchronizing the received frame in response to recognizing the first number of frame synchronization bytes having the first value and the second number of frame synchronization bytes having the second value.

90. The system of claim 88 wherein the overhead receiver selects a first number of frame synchronization bytes having a first value in a first frame and a second number of frame synchronization bytes having a second value in a second frame, and synchronizes the received frames in response to recognizing the first number of frame synchronization bytes having the first value in the first frame and the second number of frame synchronization bytes having the second value in the second frame.

91. The system of claim 88 wherein the overhead generator selects frame synchronization bytes having a first value; and

wherein the overhead receiver selects frame synchronization bytes having the first value.

92. The system of claim 88 wherein the overhead generator selects a first number of frame synchronization bytes having a first value and a second number of frame synchronization bytes, having a second value; and

wherein the overhead receiver selects a third number of frame synchronization bytes less than the first number, having the first value, and a fourth number of frame synchronization bytes less than the second number, having the second value, the overhead receiver synchronizing the received frame in response to recognizing the third number of frame synchronization bytes having the first value, and the fourth number of frame synchronization bytes having the second value.

93. The system of claim 72 wherein the overhead receiver falls out of synchronization in response to frame synchronization byte non-recognition.

94. The system of claim 93 wherein the overhead receiver accepts commands for selecting a number of consecutively non-recognized frames, and falls out of synchronizing in response to the selected number of consecutively non-recognized frames.